

1 **ROTARY CABLE TREATMENT METHOD AND APPARATUS**

2 FIELD OF THE INVENTION

3 This invention is related to the cable treatments and in
4 particular, to a method and apparatus for treating non-circular
5 cables with a lubricant or rust inhibitor at high pressure.

6 BACKGROUND OF THE INVENTION

7 Cables used in marine and land based applications are
8 bundles of organized metal wires that provide strength in
9 tensile loading applications. These cables are used on many
10 applications seen every day just driving down the highway.
11 Cranes used to lift cargo, draglines used in digging,
12 suspension bridges, guy wires on antenna systems and building
13 elevators are a few land based examples.

14 These examples also pertain to use offshore with the
15 addition of mooring cables used to anchor floating systems to
16 the ocean floor and umbilical systems used to tow underwater
17 scientific packages behind ships. There are many other
18 applications, but this list demonstrates the broad range of
19 cable usage in the world today.

20 All of these cables are subject to corrosion with time. In
21 offshore applications, this time is greatly reduced due to the
22 salt water's ability to corrode metals at an accelerated rate.
23 There are several techniques currently used to fight the
24 corrosion problems of both land based and marine applications.

1 One such technique is the use of galvanized cable. The benefit
2 of using galvanized cable is that the galvanizing material,
3 molten zinc, is applied to the individual wires during the
4 manufacture of the cable, resulting in a relatively minor cost
5 impact. The galvanic coating process results in a relatively
6 maintenance free cable, cable life is substantially extended,
7 and the coating is relatively inexpensive. The negative
8 aspects of the galvanic process are a reduction in the cable
9 capacity for a given diameter of wire as the high strength wire
10 has to be processed at a reduced diameter to allow for the
11 additional zinc build-up during galvanizing (the change in
12 diameter is squared in stress calculations, resulting in a
13 significant impact on ultimate cable strength), cable system
14 diameter must increase for the same load rating resulting in
15 increase in all components the cable rolls across and is stored
16 on, yielding a concomitant increase in overall system weight.

17 Thus, the relatively inexpensive galvanizing ultimately
18 results in a significant cost increase to the total system, in
19 salt water applications, break down of the zinc occurs fairly
20 rapidly, and once the galvanizing is consumed by the salt water
21 the cable must be replaced fairly quickly.

22 An alternative technique is the application of manually
23 applied rust inhibitors. Use of rust inhibiting materials
24 protects non-galvanized as well as galvanized cables, extends

1 the life of galvanized and non-galvanized cables, can be re-
2 applied as needed, and can be applied for the first time during
3 the manufacturing of the cable. Detriments inherent in the use
4 of such materials is that their application is messy, uniform
5 application is extremely difficult, getting the inhibitor to
6 penetrate to the core of the cable is very difficult with the
7 high viscosity styles of inhibitors, service life is short with
8 the brush-on low viscosity styles of inhibitors, and saltwater
9 washes out the inhibitor with time.

10
11 DESCRIPTION OF THE PRIOR ART

12 U.S. Patent No. 4,862,996 discloses a process wherein a
13 liquid is applied to a wire rope by passing the rope through an
14 elongated casing in which liquid is sprayed against the rope,
15 excess liquid being discharged through annular grooves
16 containing discharge openings upstream and downstream of the
17 liquid inlet. Air is blown against the rope upstream and
18 downstream of the annular grooves and discharge openings for
19 causing the liquid to be discharged through such openings and
20 not through the ends of the casing.

21 U.S. Patent No. 5,333,704 discloses a device wherein a
22 lubricant is applied to a lubrication point by moving an
23 emitter in a first portion of a movement path through lubricant
24 in a reservoir and then moving the emitter through a second

1 portion of the movement path. The emitter is loaded with
2 lubricant in the first portion of the movement path and is
3 drained from a drain port during the second portion of the
4 movement path. The lubricant drained from the emitter is
5 distributed to the lubrication point. A distribution device may
6 be positioned below the emitter to collect the lubricant
7 drained from the emitter and to distribute the collected
8 lubricant to a lubrication point or position other than a
9 position below the emitter during the second portion of the
10 movement path.

11 U.S. Patent No. 4,063,617 provides an apparatus wherein a
12 cable is passed through a lubricant filled chamber comprising
13 an open housing and first and second flexible, annular discs
14 each having radial slits along its inner circumference. A third
15 flexible annular disc adjacent to said second disc includes
16 radial slits on its inner circumference rotatably displaced
17 from said second disc slits. The inner circumferences of the
18 discs deformably engage the cable whereby lubricant beads are
19 deposited at the second disc, which beads are uniformly spread
20 by the deformably engaged sections of the third disc.

21 U.S. Patent No. 5,107,961 provides a fixture facilitating
22 the lubrication of cables including a housing having a clamping
23 portion and a resilient insert to receive and capture the
24 elongate cable and the end of the cable sheath, the

1 compressible material being clamped around these portions. A
2 valved lubricant aperture is provided in the fixture for
3 introducing lubricant under pressure to the cable sheath while
4 preventing blowback of the pressurized lubricant. The
5 compressible insert in the fixture is designed to be captured
6 in the base of one portion of the fixture and at another point
7 in the moving portion of the fixture to allow it to be opened
8 and closed for insertion and removal of the cable and sheath.

9 U.S. Patent No. 4,422,529 teaches a method of lubricating
10 steel cable wherein the steel cable is drawn through a chamber
11 containing lubricant under pressure. The chamber has an outlet
12 and an inlet lined with rubber sleeves through which the cable
13 passes. A liquid lubricant is utilized, preferably a
14 lubricating oil, which is supplied to the chamber by means of
15 a pump having a high delivery pressure, minimum 20 bar and
16 preferably above 40 bar, but with a relatively small delivery
17 capacity. The rate of passage for the steel cable through the
18 chamber is adapted such that the hollow spaces in the steel
19 cable absorb the supplied oil to such an extent that oil
20 leakage is avoided. The apparatus for carrying out the method
21 comprises a chamber for lubricant under pressure, having an
22 inlet and an outlet for the steel cable. A supply hose for
23 lubricant leads to the chamber, and a pressure pump ensures
24 pressure in the lubricant. The pump is a suction pump which can

1 deliver a pressure of at least 20 bar, preferably above 40 bar,
2 but has a small delivery capacity.

3 U.S. Patent No. 4,336,866 is drawn to a wire rope
4 lubricator cleaner for applying to a wire cable a lubricant
5 cleaner, and removing from the wire cable excess lubricant
6 cleaner so as to lubricate and clean the wire cable. A
7 lubrication canister removably coupled to a rectangular shaped
8 frame assembly applies the lubricant cleaner to the wire cable.
9 A die rotatably mounted on an upper slide assembly of the
10 rectangular shaped frame removes the excess lubricant from the
11 cable and cleans the wire cable.

12 U.S. Patent No. 3,951,235 is drawn to a greasing device
13 for cables comprising at least one hollow body having walls
14 defining an inner chamber adapted to be filled with a
15 predetermined quantity of a lubricating material having a
16 relatively high coefficient of viscosity, and a predetermined
17 pressure. At least one pair of apertures are provided through
18 said walls for a cable to be greased to extend therethrough and
19 across said inner chamber so as to come into contact with said
20 lubricating material inside said chamber; the size of said
21 apertures being such that a predetermined clearance is present
22 between the periphery of each aperture and the surface of the
23 cable when the latter is mounted through the greasing device.
24 A weighted member travels through the chamber housing, while

1 acting on the grease therein, to force the grease toward the
2 cable passing through the housing and toward the apertures in
3 the housing through which the cable passes.

4 U.S. Patent No. 4,498,558 teaches a lubricating device
5 which is provided for greasing wire ropes and cables comprising
6 a diametrically split housing with clamps to close the housing
7 about the cable. Within the housing is a diametrically split
8 core body of hard elastomeric material having an axial bore
9 through which the cable travels axially. At the center of the
10 core body is an internal cavity through which the cable passes
11 and which is kept supplied with grease under pressure. Toward
12 its ends the core body has two further internal cavities
13 through which the cable passes, which serve to collect surplus
14 grease. Between and beyond the grease supply and collection
15 cavities, the axial bore of the core body is profiled so that
16 each length of it has the form of an internal triangular
17 section or Vee threaded screw thread; except that the
18 directions of the screw thread are mutually reversed in the two
19 halves of the split core body. The minimum diameter of the
20 screw threads is substantially equal to the cable diameter so
21 that sealing contact occurs between the cable and the thread
22 peaks. At its ends, the housing is fitted with scraper plates
23 having central holes, through which the cable passes, of
24 substantially the same

1 diameter as the cable.

2 What is lacking in the prior art is a cable treatment
3 device for use in cleaning, lubricating or coating of a cable
4 that is adapted to the follow the natural helix of the cable to
5 provide high pressure treatment of a cleaner, lubricant or high
6 viscosity inhibitor with minimal fluid loss by extending the
7 life of the sealing mechanism and minimum wear to the cable.

8

9 SUMMARY OF THE INVENTION

10 Currently, low viscosity brush on inhibitors are used on
11 cables with non-circular cross-sections and the high viscosity
12 inhibitors can be applied to circular cross-section cables with
13 a pressure applicator. The present invention provides a
14 pressure applicator having a configuration and seal design
15 which enables sufficient pressure generation to provide
16 complete penetration of the lubricant within the section of
17 cable being treated. The design provided by the instant
18 invention not only functions with cables having a non-circular
19 cross-section, but it also provides a superior sealing for
20 treatment of circular cables.

21 This design provides a significant benefit by insuring
22 application of a superior high viscosity inhibitor to all
23 cables as long as physical space allows. The rotation
24 capability reduces seal wear on the circular cross section

1 cables by following the helix formed by the outer layer wire.

2 Accordingly, it is an objective of the instant invention
3 to provide a rotary cable treatment assembly to coat a cable
4 with either a pressurized lubricant or fluid rust inhibitor.

5 It is a further objective of the instant invention to
6 provide a lubricator capable of applying sufficient pressure to
7 impregnate the entirety of the cable's cross section.

8 It is yet another objective of the instant invention to
9 provide a rotary cable lubricator having a seal structure
10 adapted to follow the cable geometry while experiencing minimal
11 wear and simultaneously retaining maximum pressure.

12 Other objectives and advantages of this invention will
13 become apparent from the following description taken in
14 conjunction with the accompanying drawings wherein are set
15 forth, by way of illustration and example, certain embodiments
16 of this invention. The drawings constitute a part of this
17 specification and include exemplary embodiments of the present
18 invention and illustrate various objects and features thereof.

19

20

21

1 BRIEF DESCRIPTION OF THE FIGURES

2 Figure 1 is an isometric view of the cable treatment
3 assembly device;

4 Figure 2 is an end view of the assembly;

5 Figure 3 is an isometric view of half the shell that forms
6 the stator;

7 Figure 4 is a perspective view of the rotor assembly;

8 Figure 5 is a perspective view of the rotor assembly
9 placed with the stator; and

10 Figure 6 is a partial side view illustrating a non-
11 circular cable.

12
13 DETAILED DESCRIPTION OF THE INVENTION

14 Now referring to Figures 1 and 2, set forth is a stator
15 assembly 10 formed from a first generally semi-cylindrical
16 shell 12 having an inner surface 14 and an outer surface 16
17 with a proximate endwall 18 located along a first end of the
18 shell 12 and a distal endwall 20 located along a second end of
19 the shell 12. A second generally semi-cylindrical shell 22
20 also includes an inner surface and outer surface with a
21 proximal and distal endwall forming a mirror image of the inner
22 surface and the endwalls 18, 20 of the first shell 12. The
23 first shell 12 is securable to the second shell 22 by use of
24 screw fasteners 24 and bolt fasteners 26. It should be noted

1 that various fastening techniques may be used that are capable
2 of maintaining the shells together when the cavity formed
3 between the shells 12,22 is subjected to a pressure in excess
4 of 3000psi. Pressurize fluid may be injection through port 17
5 with a gauge 19 mounted, directly or indirectly, to the stator
6 providing an accurate indication of cavity pressure. A gasket
7 seal is placed within gasket slot 30 to prevent fluid from
8 escaping the shells.

9 The endwalls 18,20 of the first shell 12 and the mirror
10 image endwalls of the second shell 22 cooperate to form an
11 aperture 32 adapted to encircle a cable having a circular or
12 non-circular cross section traveling axially through the stator
13 10. To allow the stator 10 to easily coupled to a cable, the
14 second shell 22 can be hingedly attached by attachment arms 34
15 and 36 that engage a receptacle 38 formed in the first shell
16 12. The hinge design allows for a uniform clamping of the
17 shells by aligning the shells during installation.

18 Referring to Figure 3, the inner surface shells are formed
19 to receive a rotor assembly. The inner surface 14 of shell 12
20 includes a preformed seal section 40 located along the proximal
21 endwall 18 and a second seal section 42 located at along distal
22 endwall 20. Between seal sections 40 and 42 is the injection
23 cavity 42 that may include a spacer pipe, described later in
24 this specification, that may be used between the seals. It

1 should be noted that the seals may be considered the rotor
2 assembly, without or with out a spacer pipe. Each seal section
3 40 and 42 of the rotor assembly includes a detent that accepts
4 a corresponding protrusion located on the outer surface of the
5 seals that operate to maintain the seals in position and
6 further inhibits passage of fluid around the seals.
7 Alternatively, the rotor assembly may include a protrusion
8 along an outer surface with the shell surface having a
9 corresponding detent.

10 Figure 4 illustrates the rotor assembly 50 which is
11 designed and arranged to fit around a cable traveling axially
12 52 through the rotor 50. The rotor 50 has a centrally located
13 aperture 54 designed and arranged to fit around the cable and
14 has a first luber seal 56 positioned at one end 58 of the
15 cavity 52 and a second luber seal 60 positioned at the other
16 end 64 of the cavity 54. The cavity 54 may be consist of a
17 space pipe 64 to assist in maintaining the seals depending on
18 the type of cable to be treated. Fluid injection port 68
19 accepts pressurized fluid into the cavity 54 wherein spacer
20 pipe 64 may include a nozzle injector port 70 to delivery the
21 fluid around the cable that is passed through the rotor
22 assembly 50. As shown in Figure 5, seals 58 and 60 have an
23 outer surface conforming to the inner surface of the stator
24 shell 12 and an inner surface 72 conforming to the outer

1 surface of a cable. The luber seals 56 and 60, each are
2 constructed from polyurethane or the like material that
3 provides deformability at high pressure but remain highly
4 resistant to wear. Unique to this invention is that wear
5 patterns are repeatable in that the rotor assembly rotates
6 according to the helix pattern of the cable being treated. For
7 instance, if Warrington Seale type wire rope is to be treated,
8 the cable may wear a pattern into the seal over a period of
9 time. This wear pattern enhances the sealing ability of the
10 luber seal by allowing the seal to conform to the wire strands
11 that form the helix. Alternatively, the rotor assembly can be
12 made of a non-deformable material such as 304 stainless steel
13 wherein a hydraulic seal such as a polyurethane o-ring is
14 positioned around the rotor structure to engage the sidewalls
15 of the stator and to engage the cable passing through the inner
16 rotor assembly aperture.

17 The rotor assembly is supported by bushings 80 and 82,
18 and bearing 84 and 86. The assembly is designed to operate on
19 fluid pressures of about 3000psi wherein the fluid, whether it
20 be a lubricant, a high viscosity rust inhibitor, a cleaning
21 fluid or the like, impregnates the cable to effectively coat
22 each individual wire strand.

23 The rotor assembly 50 can be sized to accommodate any size
24 cable wherein the inner surface diameter of the rotor may

1 accept a cable of a particular diameter yet continue to use the
2 same stator housing. Thus, the cable may be 1/4inch or greater
3 than 3inches, requiring only replacement of the rotor assembly.
4 The rotor can be formed from a single piece of material having
5 a diametrically split with or without the spacer pipe
6 positioned between each of the luber seals.

7 Non-circular cables are those cables, such as the wire
8 rope 90 illustrated in Figure 6 having an outer surface that is
9 not perfectly circular typically caused by a reinforcement
10 stand of wires, or armor, that forms the outer most portion of
11 the cable. For instance, non-circular cables may include those
12 designs known as a 2-Operation wire rope, a Warrington with a
13 1x19 stand core, a Seale with a 7x7 IWRC, a Filler Wire with a
14 fiber core, a Warrington Seal with a 7x7 IWRC; a Filler Wire
15 with a 7x7 IWRC, and so forth.

16 The assembly 10 provides an effective method for treating
17 a cable having a non-circular outer surface wherein a cable is
18 first positioned through the stator assembly. Fluid is then
19 injected into the stator assembly at a pressure sufficient to
20 impregnate the cable with the fluid while the cable is drawn
21 through the stator at a predetermined rate of passage that will
22 cause said rotor assembly to rotate in accordance with a helix
23 formed by wire strands along an outer surface of the cable and
24 allow the fluid to impregnate the cable.

1 It is to be understood that while a certain form of the
2 invention is illustrated, is not to be limited to the specific
3 form or arrangement of parts herein described and shown. It
4 will be apparent to those skilled in the art that various
5 changes may be made without departing from the scope of the
6 invention and the invention is not to be considered limited to
7 what is shown and described in the specification and drawings.
8